

## CLAIMS

1. An apparatus comprising:  
an elongated housing structure extending from an inlet end to an outlet end along a longitudinal axis;  
a shaft rotatably engaged with the housing structure to rotate about the longitudinal axis;  
a plurality of paddles coupled to and protruding from the shaft, the paddles being adapted to rotatably convey and tumble foodstuffs from the inlet end to the outlet end of the housing structure; and  
a fluid delivery system adapted to apply a treatment fluid to the foodstuffs as they are conveyed, while agitated and tumbled, from the inlet end to the outlet end.
2. The apparatus of claim 1 wherein each of the plurality of paddles is generally fan blade-shaped.
3. The apparatus of claim 2 wherein each of the plurality of fan blade-shaped paddles has a bent distal end, the distal end being bent generally toward the outlet end of the housing structure.
4. The apparatus of claim 3 wherein the bent distal end of each of the plurality of generally fan blade-shaped paddles comprises a first bend and a second bend.
5. The apparatus of claim 1 wherein the housing structure, the shaft, and the plurality of paddles are made of metal.
6. The apparatus of claim 5 wherein the metal is stainless steel.
7. The apparatus of claim 1 wherein the shaft is substantially cylindrical.

8. The apparatus of claim 1 wherein the fluid delivery system is adapted to apply more than one type of treatment fluid in a sequential fashion to a foodstuff sample as it is conveyed from the inlet end to the outlet end.

9. The apparatus of claim 1 wherein the fluid delivery system is adapted to apply more than one type of treatment fluid at the same time.

10. The apparatus of claim 1 wherein the fluid delivery system comprises at least one manifold, and wherein the at least one manifold is substantially parallel to the shaft, is fitted with a plurality of spray nozzles, is situated near an opening along the top of the housing structure, and comprises a first end located near the inlet end of the housing structure and a second end located at the outlet end of the housing structure.

11. The apparatus of claim 10 wherein the at least one manifold is two manifolds.

12. The apparatus of claim 10 further comprising a means for delivering a pressurized stream of a treatment fluid to the at least one manifold and plurality of spray nozzles fitted thereto.

13. The apparatus of claim 10 wherein the plurality of spray nozzles are fitted to the at least one manifold in a regularly or irregularly spaced fashion from a point at or near the first end of the at least one manifold to a point at or near the second end of the at least one manifold, and wherein each of the plurality of spray nozzles is fitted to the manifold so as to direct spray downward toward the foodstuffs being conveyed by the rotatable shaft having the plurality of paddles attached thereto and protruding therefrom.

14. The apparatus of claim 13 wherein at least one of the plurality of spray nozzles is configured to deliver a spray in the form of a fog.

15. The apparatus of claim 13 wherein at least one of the plurality of spray nozzles is configured to deliver a cone-shaped spray.

16. The apparatus of claim 13 wherein at least one of the plurality of spray nozzles is configured to deliver a fan-shaped spray.

17. The apparatus of claim 13 wherein the plurality of spray nozzles are configured so that the flow rate of the treatment fluid sprayed from any one of the plurality of spray nozzles may be the same as or different from the flow rate of the treatment fluid sprayed from any of the other spray nozzles.

18. The apparatus of claim 13 wherein the plurality of spray nozzles are configured so that the flow rate of the treatment fluid sprayed from spray nozzles fitted to the manifold toward its first end is greater than the flow rate of the treatment fluid sprayed from spray nozzles fitted to the manifold toward its second end.

19. The apparatus of claim 1 wherein the treatment fluid is a disinfectant or fungicide.

20. The apparatus of claim 19 wherein the disinfectant or fungicide is in the form of a liquid or fluidizable solids.

21. The apparatus of claim 20 wherein the disinfectant or fungicide is selected from the group consisting of acidified sodium chlorite solutions, aqueous chlorine dioxide solutions, quaternary ammonia compounds, per-acid compounds, hydrogen peroxide, organic acids, chlorine solutions, halogen-donor compounds, metal hypohalites, electrolyzed water, ozone solutions, natural floral or faunal extracts, enzymatic products, surface-active agents, and mixtures thereof.

22. The apparatus of claim 1 wherein the treatment fluid is a flavoring agent in the form of a liquid or fluidizable solids.

23. The apparatus of claim 1 wherein the treatment fluid is a tenderizing agent, texturizing agent, or preservative in the form of a liquid or fluidizable solids.

24. The apparatus of claim 1 wherein the housing structure comprises substantially planar first and second side-wall portions and a rounded bottom portion, the first and second side-wall and bottom portions forming a generally U-shaped cross-section when viewed along the length of the housing structure, and the diameter of the semi-circular portion of the U-shaped cross-section being slightly greater than the diameter of the largest circular arc traced by the plurality of paddles as the shaft rotates; wherein the housing structure forms an opening at the top, the opening extending along substantially the entire length of the housing structure and being of substantially uniform width.

25. The apparatus of claim 24 wherein the shaft is adapted to rotatably convey and tumble the foodstuffs from the inlet end of the housing structure to the outlet end of the housing structure as the shaft rotates in a direction that is clockwise when the rotation is viewed from the inlet end toward the outlet end, and wherein the at least one manifold of the fluid delivery system is located closer to the first side-wall than to the second side-wall.

26. The apparatus of claim 24 further comprising a hingedly connected or removable top configured to cover the opening when closed or installed.

27. The apparatus of claim 26 wherein the fluid delivery system is enclosed within the housing structure when the top is closed or installed.

28. The apparatus of claim 24 wherein neither end of the housing structure is substantially elevated in relation to the other end.

29. The apparatus of claim 24 wherein the inlet end of the housing structure is elevated in relation to the outlet end.

30. The apparatus of claim 24 wherein the outlet end of the housing structure is elevated in relation to the inlet end.

31. The apparatus of claim 30 wherein the outlet end of the housing structure is elevated in relation to its inlet end to an extent such that the shaft is at an angle of about 10° to about 20° from the horizontal.

32. The apparatus of claim 30 wherein the shaft is at an angle of about 15° from the horizontal.

33. The apparatus of claim 24 wherein the housing structure comprises at least one leg having an adjustable height.

34. The apparatus of claim 24 wherein the bottom portion of the housing structure comprises a drain located at the inlet end of the housing structure.

35. The apparatus of claim 1 wherein the foodstuffs are in whole form or in parts thereof.

36. The apparatus of claim 35 wherein the foodstuffs comprise meat.

37. The apparatus of claim 35 wherein the foodstuffs comprise seafood.

38. The apparatus of claim 35 wherein the foodstuffs comprise fruits.

39. The apparatus of claim 35 wherein the foodstuffs comprise vegetables.

40. The apparatus of claim 1 wherein the plurality of paddles attach to the shaft along a generally helical path, and wherein the paddles are aligned along a generally spiral plane projecting outwardly from the helical path.

41. The apparatus of claim 40 wherein the plurality of paddles are interconnected by a web, the web being connected to the rotatable shaft; wherein the web and interconnected plurality of paddles form a continuous, generally spiraling surface along an operable length of the shaft; and wherein the intersection of the continuous, generally spiraling surface and the rotatable shaft is continuous from a first end to a second end of the generally spiraling surface.

42. The apparatus of claim 41 wherein the generally helical surface is made of metal.

43. The apparatus of claim 42 wherein the metal is a stainless steel.

44. The apparatus of claim 41 wherein each of the plurality of paddles comprises a curved blade, each of the curved blades comprising a first portion and a second distal portion, the first portion being substantially aligned with the generally spiraling surface, and the second distal portion angling away from the generally spiraling surface and toward the outlet end of the housing structure.

45. An apparatus comprising:  
an elongated housing structure extending from an inlet end to an outlet end along a longitudinal axis;  
a shaft rotatably engaged with the housing structure to rotate about the longitudinal axis;

a spiral blade attached to and protruding from the shaft and continuously spiraling around the shaft, the shaft and blade being adapted to rotatably convey and tumble foodstuffs from the inlet end to the outlet end as the shaft rotates; and

a fluid delivery system adapted to apply a treatment fluid to the foodstuffs as they are rotatably conveyed, while agitated and tumbled, from the inlet end to the outlet end.

46. The apparatus of claim 45 wherein the housing structure comprises first and second side-wall portions and a bottom portion, the first and second side-wall and bottom portions forming a generally U-shaped cross-section when viewed along the length of the housing structure, and the diameter of the semi-circular portion of the U-shaped cross-section being slightly greater than the diameter of the spiral blade; wherein the housing structure forms an opening at the top, the opening extending along substantially the entire length of the housing structure and being of substantially uniform width.

47. The apparatus of claim 46 wherein the at least one manifold of the fluid delivery system is located closer to the first side-wall than to the second side-wall.

48. The apparatus of claim 45 wherein each flight of the spiral blade comprises one or more protrusions attached thereto, each of the one or more protrusions continuously extending radially from the shaft to, or near to, the distal edge of the spiral blade, protruding from the surface of the spiral blade in the direction of conveyance of the foodstuffs, and having a leading edge.

49. The apparatus of claim 48 wherein the cross-section of each of the one or more protrusions, the cross-section being in a plane tangential to the shaft and perpendicular to the leading edge of the protrusion, is substantially elongated, the direction of elongation being in the direction of conveyance of the foodstuffs or foodstuff parts.

50. The apparatus of claim 49 wherein the cross-section is generally triangular or V-shaped, the triangle or V-shape narrowing in the direction of conveyance of the foodstuffs.

51. The apparatus of claim 48 wherein each flight of the spiral blade comprises one protrusion attached thereto.

52. The apparatus of claim 48 wherein each flight of the spiral blade comprises two protrusions attached thereto.

53. The apparatus of claim 48 wherein each flight of the spiral blade comprises three protrusions attached thereto.

54. The apparatus of claim 48 wherein each flight of the spiral blade comprises four protrusions attached thereto.

55. The apparatus of claim 54 wherein the angle of rotation from one protrusion to the next along a flight of the spiral blade is about 90°.

56. The apparatus of claim 48 wherein each flight of the spiral blade comprises more than four protrusions attached thereto.

57. The apparatus of claim 48 wherein the protrusions are welded to the helically-shaped blade.

58. The apparatus of claim 48 wherein the protrusions are integral with the helically-shaped blade.

59. The apparatus of claim 48 wherein the protrusions are removeably attached to the helically-shaped blade.



60. The apparatus of claim 45, further comprising a plurality of paddles wherein the spiral blade is attached to and protrudes from a first longitudinal portion of the rotatable shaft, and the plurality of paddles is attached to and protrudes from a second longitudinal portion of the rotatable shaft.

61. The apparatus of claim 60 wherein the first longitudinal portion extends from that end of the rotatable shaft closest to the inlet end of the housing structure to a point about one-third of the way to the other end of the rotatable shaft.

62. The apparatus of claim 60 wherein the first longitudinal portion extends from that end of the rotatable shaft closest to the inlet end of the housing structure to a point about one-half of the way to the other end of the rotatable shaft.

63. A method for applying a treatment fluid to surfaces of foodstuffs, comprising the steps of:

introducing foodstuffs into an inlet end of an elongated apparatus;

introducing, by means of a fluid delivery system, an effective amount of a treatment fluid into the apparatus so as to effect contact between the treatment fluid and substantially all of the surfaces of the foodstuffs as the latter are rotatably conveyed, while agitated and tumbled, from an inlet end to an outlet end of the apparatus, the effective amount of the treatment fluid realized by having 1) a sufficient flow rate of the treatment fluid from the fluid delivery system into the apparatus per unit mass of foodstuffs treated, and 2) a sufficiently long time of travel of the foodstuffs from the inlet end to the outlet end of the apparatus.